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HBCUs Research Conference Agenda and Abstracts

April 1998

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HBCUs Research Conference Agenda and Abstracts

Proceedings of a conference held at and sponsored by
Ohio Aerospace Institute
Cleveland, Ohio
April 8–9, 1998

National Aeronautics and
Space Administration

Lewis Research Center

April 1998

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LeRC HBCUs CONFERENCE

HBCUs RESEARCH CONFERENCE

APRIL 8-9, 1998

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National Aeronautics and
Space Administration

Lewis Research Center
Cleveland, OH 44135-3191

Reply to Attn of:

NASA Lewis Research Center's commitment to excellence continues to grow in terms of investment and support for Historically Black Colleges and Universities (HBCUs). Over the last 5 years, Lewis' total research and development grant awards to 19 HBCUs exceeded its performance goal by a substantial margin.

Lewis' HBCUs Research Program is designed to utilize the ability of HBCUs to conduct fundamental science and develop physical infrastructure related to NASA's disciplines. To reach our goals, we must build partnerships with other Government agencies, industry, and academia. Our research partnerships with the Nation's HBCUs are an integral part of our strategy.

The HBCUs Research Conference is a critical element in ensuring the success of Lewis' research programs. In addition, it provides a forum for showcasing the research capabilities of the participating HBCUs.

It is with great pleasure that I welcome the participants and congratulate everyone associated with the Fifth NASA HBCUs Research Conference.

Donald J. Campbell
Director

National Aeronautics and
Space Administration

Lewis Research Center
Cleveland, OH 44135-3191

Reply to Attn of:

This Research Conference is the fifth one at which researchers and students from Historically Black Colleges and Universities (HBCUs) present progress reports on Lewis-sponsored research. Lewis management and researchers are proud of the results obtained to date and encouraged by the competence and contributions of the Principal Investigators (PIs) and student researchers.

I welcome all presenters and congratulate you for the comprehensive quality of topics covered by your research programs. Also, I congratulate and thank the Lewis Technical Monitors for their excellent support. The phrase "Lewis means teamwork" is directly applicable to the partnerships between Lewis and HBCUs.

Julian M. Earls
Deputy Director for Operations

FIFTH HBCUs RESEARCH CONFERENCE
April 8-9, 1998

AGENDA

Presiding: Dr. Sunil Dutta
SDB Program Manager

Wednesday, April 8, 1998

8:00 - 8:30 a.m.	Registration
8:30 - 9:00 a.m.	Introduction and Welcome **Dr. Julian M. Earls** Deputy Director for Operations NASA Lewis Research Center **Dr. Michael J. Salkind** President Ohio Aerospace Institute
9:00 -10::00 a.m	Oral Presentations Three (3) Concurrent/Parallel Sessions
10:00 -10:30 a.m.	Break
10:30 -12:00 Noon	Oral Presentations
12:00 -1:00 p.m.	Lunch (On Your Own)
1:00 - 3:00 p.m.	Oral Presentations
3:00 - 3:30 p.m	Break
3:30 - 5:00 p.m.	Oral Presentations

Thursday, April 9, 1998

8:00 - 8:30	Introduction and Welcome **Dr. Julian M. Earls** Deputy Director for Operations NASA Lewis Research Center **Dr. Michael J. Salkind** President Ohio Aerospace Institute **Mr. Donald J. Campbell** Director NASA Lewis Research Center

	Mr. Richard S. Christiansen Acting Associate Administrator for Aeronautics and Space Transportation Technology NASA Headquarters
8:30 - 12:00 Noon	NASA Headquarters Small Disadvantaged Business Forum (Continuation of HBCUs Research Conference)
12:00 - 1:00 p.m	Lunch (On Your Own)
1:00 - 3:00 p.m	Poster Sessions
3:00 - 4:00 p.m.	Individual Principal Investigator/Technical Monitor Meeting
4:00 - 5:00 p.m	Remove Posters

HBCU Research Conference
List of Poster Papers
April 8-9, 1998

P1	Alabama A&M University	"Optical Sensors Based on Single Arm Thin Film Waveguide Interferometer"
P2	Clark Atlanta University	"Turbulent Premixed Methane-Air Combustion: Emissions, Characteristics and Modeling"
P3	Clark Atlanta University	"X-ray Diffraction Studies of the Structure and Thermochemistry of Alkaline-Earth Oxide-Coated thermionic Cathodes"
P4	Clark Atlanta University	"Growth and Characterization of III-V Semiconductors for Device Applications"
P5	Clark Atlanta University	"Fatigue Testing of Unidirectional T650-35/AMB 21 Laminates"
P6	Clark Atlanta University	"The Construction of Finite Difference Schemes Having Special"
P7	Clark Atlanta University	"Influence of Material Distribution on Impact Resistance of Hybrid Composites"
P8	Fisk University	"Nanocrystals Formed by Laser Ablation and Ion Beams and Their Application to Photovoltaic Devices"
P9	Florida A&M University	"PLD Growth of Boron Nitride Thin Films for Alphavoltaic Device Applications"
P10	Grambling State University	"Polymerizable Monomer Reactants—Modified Polyimides"
P11	Hampton University	"Parallelization of Rocket Engine System Software (PRESS)"
P12	Hampton University	"An Analytical Description of Phase Mask Defects as Verified by Grating-Fiber Image Reproduction"
P13	Hampton University	"Preliminary Fringe-Counting Verification Wavelength Standard"
P14	Hampton University	"UV Induced Densification and Ablation During the Formation of Bragg Gratings in SiO_2 Preforms, Optical Fibers, and Gradient Index Lenses"
P15	Hampton University	"Theoretical Formulations Towards the Solution of Radiation Loss Problems in Optical Waveguide Couplers with Selectable Power Splitting Ratios"
P16	Howard University	"Design and Implementation of An Intelligent Fuzzy Logic-Based Controller for Position/Speed Control and Tracking of Permanent Magnet Motor Drives"
P17	Howard University	"Design of a Microcontroller for PM DC Motor Drives"
P18	Howard University	"Laser Optogalvanic Spectroscopy of Argon and Neon for Normal and Microgravity Combustion"
P19	Howard University	"Analysis of Thermal State-of-Charge in Solar Heat Receivers"

P20	Howard University	“Aerospace Power System Automation - Using Everett Method”
P21	Howard University	“Artificial Neural Network, Fuzzy Logic and Expert Systems Approaches to Hybrid Electric Vehicle Control System”
P22	Jackson State University	“Expert System Architecture for Rocket Engine Numerical Simulators: A Vision”
P23	NC A&T State University	“Aerothermo-Structural Analysis of Low Cost Composite Nozzle/ Inlet Components”
P24	NC A&T State University	“Numerical Simulations of Wing-Body Junction Flows”
P25	NC A&T State University	“Mechanical Behavior and Analytical Modeling of Melt-Infiltrated SiC/SiC Woven Composite”
P26	NC A&T State University	“Coupled Brillouin and Shape Memory Alloy Systems for Active Vibration Control”
P27	Savannah State University	“Photovoltaic-Diesal Hybrid Supervisory Control and Data Acquisition System Design”
P28	Savannah State University	“Supervisory Control and Data Acquisition Experimental Plan Using Photovoltaic-Diesel Hybrid Systems”
P29	Savannah State University	“Narrow Angle Diversity Study Using ACTS Ka-band Signal with Two USAT Ground Stations”
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P31	Southern University	“Knowlege Preservation and Web-tools”
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P35	Tennessee State University	“Non-Destructive Determination of Time-Dependent Thermal Conductivity of Melting Two-Phase Medium”
P36	Tennessee State University	“Numerical Modeling of Two-Dimensional Convective Melting of Granular Packed Beds”
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P38	Tuskegee University	“Characterization of Flow Behind The Fan of a Turbofan Engine”
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Optical Sensors Based on Single Arm Thin Film Waveguide Interferometer

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ABSTRACT

Single-arm dual-mode optical waveguide interferometer utilizes interference between two modes of different order. Sensing effect results from the change in propagation conditions of the modes caused by the environment. The waveguide is made as an open asymmetric structure containing a dye-doped high temperature polyimide film onto a silica substrate. It is more sensitive to the change of environment than its conventional polarimetric analog using orthogonal modes (TE and TM) of the same order. The sensor still preserves the option of operating in polarimetric regime using a variety of mode combinations such as TE_0/TM_0 (conventional), TE_0/TM_1, TE_1/TM_0, or TE_1/TM_1 but can also work in nonpolarimetric regime using combinations TE_0/TE_1 or TM_0/TM_1. Experimental sensor based on TE_0/TE_1 combination demonstrated 2π-phase shift between the modes per 2 °C change of ambient temperature. Utilization of different mode combinations simultaneously makes the device more versatile. Application of the sensor to gas sensing is based on doping polymer film with an organic indicator dye targeting a particular gaseous reagent. Change of the optical absorption spectrum of the dye caused by the gas results in change of the reactive index of the dye-doped polymer film which is detected by the sensor. As indicator dyes, we utilize temperature durable metal substituted phthalocyanines (such as Octadecyloxy copper phthalocynaine) which demonstrate a significant change of the absorption spectrum being exposed to acidulous or alkaline atmosphere. Indicator dye Bromocresol Purple doped into polymer Poly(methyl) methacrylate was also used in detecting small concentrations of ammonia. We discuss the design of the experimental gas chamber and the characteristics of the interferometer as a NOX sensor. The proposed sensor can be used as a robust stand-alone instrument for continuous environment pollution monitoring.

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Turbulent Premixed Methane-Air Combustion: Emissions, Characteristics and Modeling

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ABSTRACT

This paper reports flame-structure and emission characterization results of a premixed methane-air burner. The flow velocity distributions, streamlines and vorticities were measured and recorded using a Dantec Dual Cavity Particle Image Velocimeter (PIV) for both cold and hot (with flame) premixed jets. A cold air flow at 1.4 m/s jet penetrated 7 D above the nozzle without much disturbance. In the region of 7.5 to 16 D above the nozzle, vortices were formed on both sides of the main flow-stream. On each side of the main stream, there was a 3 mm mixing region, where the stationary gases mixed with the main stream, which made the streamlines of the flow appear about twice as wide as the nozzle. With the flame, the flow jet quickly expanded several times in volume, and the flow speed significantly increased from its corresponding cold flow value, Some of the flame packets were entrained into the reverse flowing stream of the large stationary vortex and were transported upstream. Just before an active period of vortex shedding, the rotational velocity about the stationary vortex center increased. As the shed vortex rotated, it picked up the flame packets around the combustor, thus making the shed vortex visible in the image picture. These results represent one of the first published PIV data for premixed flames. The numerical modeling results were compared and used to explain the experimental results. In the fuel-lean region, the concentrations of CO in the exhaust were in the 200 - 300 ppm range. In the fuel-rich region, the CO concentrations quickly jumped to thousands ppm or more as the equivalence ratio, Φ, increased. CO_2 reached its maximum value of about 10% at $\Phi = 1$, where complete combustion occurred. NO_x formation was also strongly dependent on the equivalence ratio at which the burner was operated. It reached its maximum of 58 ppm at $\Phi \approx 1$, and decreased significantly as the operation moved away from stoichiometric. The total flow rate was found to have a significant effect on the combustion characteristics of the premixed burner. As the total flow increased, the O_2 concentration decreased, but the UHC, CO, CO_2 and NO_x concentrations increased, and the NO_x curve shifted to the fuel-lean region. The nozzle materials and sizes were found to be critical for the premixed combustion. High thermal conductivity materials (e.g. aluminum) led to low temperatures (<100 °C) at the nozzle, which resulted in unstable flames. Low thermal conductivity nozzles (e.g. marble) produced higher CO_2 concentrations because of the higher combustion temperature. As the width of the nozzle increased, the curve of the CO_2 concentration became broader and less sensitive to the fuel-air ratio, and the amount of $N0_x$ formed increased and its curve shifted toward the fuel-lean region.

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X-ray Diffraction Studies of the Structure and Thermochemistry of Alkaline-Earth Oxide-Coated Thermionic Cathodes

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ABSTRACT

NASA LeRC has a broad, active cathode technology development program in which both experimental and theoretical studies are being employed to further development of thermionic cathodes for use as electron sources in vacuum devices for communications and other space applications. One important type of thermionic cathode under development is the alkaline-earth oxide-coated (BaO, SrO, CaO) cathode. Significant improvements in the emission characteristics of this cathode have been obtained through modification of the chemical composition and morphology of the oxide coating, with the best result thus far coming from the addition of In_2O_3 and Sc_20_3. Whereas the In_20_3 produces a finer, more uniform particle structure, the exact chemical state and role of the Sc_20_3 in the emission enhancement is unknown. The purpose of this cooperative agreement is to combine the studies of the surface chemistry and electron emission at NASA LeRC of chemically modified oxide coatings with a study of the, thermochemistry and crystal structure using X-ray diffraction equipment and expertise at Clark Atlanta University (CAU). The study at CAU is intended to provide the description and understanding of the structure and thermochemistry needed for further improvement and optimization of the modified coatings. A description of the experimental procedure, preliminary X-ray diffraction test results, together with the design of an ultrahigh vacuum chamber necessary for high temperature thermochemistry, studies, will be presented.

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Growth and Characterization of III-V Semiconductors for Device Applications

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ABSTRACT

The research goal is to achieve a fundamental understanding of the physical processes occurring at the surfaces and interfaces of epitaxially grown InGaAs/GaAs (100) heterostructures. The epitaxial growth of InGaAs based systems is characterized by the segregation of In at the growth front and at interfaces with other arsenides, particularly those with higher heats of formation (e.g., Ga and Al) and smaller covalent radii. This segregation results in poor composition profiles and poor interfacial width control. Transport devices such as modulation doped field effect transistors are adversely affected by the resultant changes in the potential energy profiles. The obvious effect is a change in the emitter to base or/and base to collector capacitance (or bias voltage). Additionally, the segregation results in a change in the alloy concentrations at the interfaces and surfaces of the device. The effect of this latter phenomenon in transport devices is the modification of the density of scattering centers, i. e., alloy scattering effects on the mobility of the charge carriers. A careful consideration of the effects of In segregation on the electronic structure and stoichiometry in the devices will lead to a significant improvement in quality without changes in the device fabrication process. We have tentatively identified two mechanisms for In segregation in material grown by solid source molecular beam epitaxy. Concurrently, we are attempting to correlate the In incorporation rate found in the metal organic chemical vapor deposition process to that of the chemical beam epitaxial growth methodology. The material characterization tools employed are secondary ion mass spectrometry and ultraviolet photoemission spectroscopy.

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Fatigue Testing of Unidirectional T650-35/AMB 21 Laminates

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ABSTRACT

An experimental study is conducted to investigate the mechanical behavior of the unidirectional T650-35 carbon fiber/AMB-21 polyimide laminates. Quasi-static tensile and fatigue properties are examined. Applied loads and resulting strains are recorded. Accomplishments include successful fatigue testing with tabbed dog-bone shaped specimens in which failure occurred away from the tabs. A cyclic load frequency of 10 Hz with a sinusoidal command wave form was employed. Young's Modulus was continuously monitored throughout the test by recording the strain and the associated load. All specimens failed suddenly in a fiber broom failure type associated with "popping" sounds caused by the fiber bundles fracturing. The fatigue life diagram for tension-tension loading of the unidirectional T650-35/AMB21 laminates is determined. The axes of the diagram are strain and logarithm of the load cycles to failure. Although fatigue testing is done under controlled load, the variable on the vertical axis of the diagram is the maximum strain attained in the first load cycle. The significance of the maximum strain is that this quantity represents the state of damage reached in the first load cycle and it is reasonable to expect that any progression of damage in subsequent load cycles will be determined by this state of damage. Furthermore the two extreme states in fatigue, i.e. the static failure and the fatigue limit, are given generically in terms of strain. The static failure occurs at the strain to failure of fibers irrespective of the fiber volume fraction and the fatigue limit is governed by the matrix. From the fatigue life diagram, the fatigue limit is found to be approximately 0.7 percent strain.

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The Construction of Finite Difference Schemes Having Special Properties

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ABSTRACT

A large class of physical phenomena may be modeled by evolution and wave type partial differential equations (PDE). Few of these equations have known explicit exact solutions. Finite-difference techniques are an important method for constructing discrete representations of these equations for the purpose of numerical integration. Our project investigates the application of so-called nonstandard finite-difference schemes for several model nonlinear and linear PDE's and associated ODE's. The major goal is to build into the discrete representation of a given PDE as many of the properties as possible as exists for the original PDE. The purpose being the elimination of numerical instabilities, i.e., solutions to the discrete equations that do not correspond to any solution of the PDE. Results are presented on the application of these methods to a class of coupled nonlinear reaction-diffusion PDE's. We show that the enforcement of a positivity condition gives functional relations between the space and time step-sizes. A detailed calculation is presented for a model chemical reaction.

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Influence of Material Distribution on Impact Resistance of Hybrid Composites

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ABSTRACT

In this study, the influence of material distribution on the impact response of a hybrid metal/polymer composite and a hybrid titanium composite laminate are investigated. Initially, a linear analytical model is proposed to evaluate the magnitude of the impact force as a function of the velocity of the impactor. This model provides a tool for estimating the magnitude of the impact load from the impact energy. For hybrid composites subjected to low and medium velocity impacts where elastic deformation is assumed, the effect of cross sectional material distribution on impact response was studied. For equal areal weight plates, the number of layers in a hybrid composite laminate does not significantly affect the impact resistance. However, the relative material ratio between metal and polymer composites affect impact response. Similarly, for plates with equal areal weights, the relative ply thickness in a laminate does not have much effect on its impact resistance, but the research shows that the total relative material distribution does significantly affect the impact response.

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Nanocrystals Formed by Laser Ablation and Ion Beams and Their Application to Photovoltaic Devices

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ABSTRACT

Nanocrystals are rapidly emerging as a new class of materials that have demonstrated a wide variety of applications in areas ranging from optoelectronic devices to combustion technology. Many other applications are on the horizon, while the basic physics and chemistry these materials begin to unfold. It is clear that nanocrystals have found their place in cutting-edge technology, but are also objects of fundamental interest to chemists and physicists. Several novel approaches have been applied to fabricating nanocrystals which include wet chemical methods, the use of porous media to geometrically confine and restrict the nanocrystal size, reverse micelle synthesis, arrested precipitation, and thermal evaporation combined with inert gas cooling. While these synthetic methods have enjoyed varied degrees of success, the ultimate product is not in a form that is amenable for device development. To address this issue, we have developed techniques that allow for directly incorporating nanocrystals into host materials that are common in optoelectronics technology. Ion beams have been used for implanting various ions and ion pairs of III- V and II-VI elements into insulator hosts (e.g. SiO_2, MgO (100) and Al_20_3) at concentration far above saturation. Post-implantation annealing in reducing and oxidizing atmospheres promotes nucleation and growth of the nanocrystals in the host matrix. Quantum dots are fabricated using this approach and are evaluated for their potential as photovoltaics. Laser ablation using ps and fs pulses with GW of peak power or the output from a continuously tunable optical parametric oscillator (460-2000 nm) are used for synthesizing nanocrystals. The nanocrystals are collected on an optically transparent substrate and then overcoated by e-beam evaporation of the same substrate. This fabrication technique allows for producing nanocrystals with potential photovoltaic applications. Because of flexibility of this approach, it is possible to select a dielectric host that will minimize the radiation effects on nanocrystals used for photovoltaics in a space environment.

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PLD Growth of Boron Nitride Thin Films for Alphavoltaic Device Applications

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ABSTRACT

The III-V compound boron nitride is very similar in many respects to carbon. In particular, the cubic phase is strikingly like diamond in terms of hardness, thermal conductivity and large optical bandgap energy. We have proposed the use of cubic boron nitride (c-BN) thin films as the basis for a type of energy conversion technology known as alphavoltaics, which has promise for small-scale space power applications. Similar in many respects to photovoltaic technology currently in use for earth-orbit satellite power systems, alphavoltaics consists of the absorption of alpha particles emitted from a long half-life radioisotope, and direct conversion of the particle energy to electricity through the creation of electron hole pairs within a p-n junction. Although c-BN is commercially available in bulk form, it has so far proved resistant to attempts at thin film formation. As an alternative to the common nitrogen ion based techniques described by other groups, we have installed an inductively coupled RF nitrogen plasma source in a custom-built pulsed laser deposition system. This source is identical to that used in molecular beam epitaxial growth of GaN laser diodes, and has been shown to produce an appreciable percentage of atomic (as opposed to ionized molecular) nitrogen species. In this presentation, we describe the results of initial film growths using the 266 nm line of a Nd:YAG laser and, more recently, a 248 nm KrF excimer laser to ablate an elemental boron target in conjunction with the nitrogen plasma source. Films of up to 1000 Å thickness have been deposited on a variety of materials, including one-inch square polycrystalline diamond substrates. Results of SEM, ESCA, Raman and FTIR spectroscopy will be presented, as well as crystalline phase verification using x-ray diffraction.

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Polymerizable Monomer Reactants—Modified Polyimides

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ABSTRACT

The main focus of this research investigation is to prepare diamine derivatives of 2,2'-Bis(p-aminophenoxy)-1,1'-biphenyl, 2,2'- Bis(p-aminophenoxy)-1,1'-biphenyl and similarly structured compounds to be used as “end-capped” moieties in the formation of modified polyimides. These modified polyimides will then be evaluated for process efficiency and thermal stability. We have been able to complete the synthesis and characterization of two important monomers (e.g., 2,2'-Bis(p-aminophenoxy)-1,1'-biphenyl and 2,2'- Bis(p-aminophenoxy) -1,1'-binaphthyl). However, 2,2'-Bis(p-aminophenoxy)-1,1' binaphthyl) was found to exhibit toxicity levels above an acceptable limit for further study. In addition to the synthesis of these compounds we outlined an efficient procedure to scale up the production of 2,2'-Bis (p-aminophenoxy)-1,1'-biphenyl. Once these compounds were prepared and characterized we prepared a polymer from the reaction of 2,2'-Bis(p-aminophenoxy)-1,1'-biphenyl- 3,3', 4,4' benzophenone-tetracarboxylic dimethyl ester (BTDE), and Nadic ester. The resulting polyimide was studied thermo-mechanically using differential scanning calorimetry (DSC), thermal gravimetric analysis (TGA), and thermal mechanical analysis (TMA). Presently, aging studies are being conducted on some of the modified polyimides.

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Parallelization of Rocket Engine System Software (PRESS)

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ABSTRACT

The principal aim is to assess parallelization requirements for various Fortran based software packages developed as part of Rocket Engine Numeric Simulator (RENS) project. During the first-year, Two-Dimensional Kinetics (TDK), a very large package. During the second-year, we have-analyzed turbine and pump design packages TURBDES/PUMPDES. For experimenting with the idea of C + + wrappers, as well as with PC platforms, we acquired access to ROCETS package on UNIX and PC platforms. Presently, we are in the process of integrating the GASP and GASPPLUS subsystems into the TURBDES/PUMPDES. All four packages have been lent to the PRESS project under different software agreements. As a result of RENS meeting in Pensacola, Florida on January 16-17, 1997, the current thrust is close cooperation with NPSS and similar projects at ACCL. To this end, we made progress in establishing an infrastructure for distributed computing. As detailed in the our second year final report, dated September 2, 1997, we successfully tested the best known distributed environment packages, Message Passing Interface (MPI) and Parallel Virtual Machine (PVM), on both HU LAN and on LeRC ACCL's LACE clusters. We have also installed and tested the GUI version under Sunsparc X-Windows at Hampton University. The main advantage of MPI and PVM is support for Fortran based code. The next step, of providing seamless distributed environment over intranets, requires the use of private packages such as CORBA or ORBIX. Such tools were designed for object-oriented languages and do not support Fortran based code. The issues involved in wrapping C + + wrappers for Fortran so as to provide a wider distributed access and computing environment has been discussed in our reports as well as by others associated with the NPSS project. At present, our aim is to run different modules of Fortran based TURBDES/PUMPDES package on distinct nodes over local nets. For this purpose, we intend to use a fairly mature, standard package MPI over our Sunsparc SunOS based local area network. Subsequently, for an actual demo in a suitable forum, we intend to repeat the same process over LeRC ACCL's IBM RS6000 Aix based LACE cluster. Finally, if time permits, the same demo will be tailored for the GUI version of PVM for performance comparisons. The accompanying presentation, while mentioning this doable demo, will primarily focus on the larger issues mentioned in the previous paragraph. The discussion will make the active participants RENS and NPSS aware of the technical difficulties in "going distributed" with the existing Fortran code. Based on our experience, we will make compelling arguments for decisions involving the translation and reworking of existing rocket engine design and simulation software to a more suitable object-oriented base using C+ + or Java.

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An Analytical Description of Phase Mask Defects as Verified by Grating-Fiber Image Reproduction

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ABSTRACT

This paper reports an investigation of the design and fabrication defects in phase is used to produce Bragg reflection gratings In optical fibers. We describe a theoretical method, closely related to optical Imaging of the phase mask diffraction patterns, which predicts the results of possible deviations from the ideal phase mask. AFM Imaging of the actual phase grating which gave rise to the anomalous fringe pattern is also fitted to theory to verify its accuracy. Phase masks with pithces of 0.566 μm, 0.896 μm, and 1.059 μm have been investigaed. Finally, in addition to examining their resutling Bragg resonances, fringe pattterns from the 0.566 μm pitch phase mask and the two beam interference pattern are compared in order to correlate defects in the mask with its near field pattern.

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Preliminary Fringe-Counting Verification Wavelength Standard

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ABSTRACT

This project involves the construction of a computer controlled double interferometer comparator for use as a writing wavelength standard. This is a CW oriented device whose application to highly accurate Bragg filter spacings could lead to standardized distributed fiber sensor networks and high volume WDM devices. The present method used to create evently spaced reflection filters is limited by both the tunable range of the writing laser, its corresponding tuning accuracy, and by the characteristic linewidth of the absorption regions involved the photosensitivity effects. Results of the preliminary work associated with this multiple sensor fabrication prototype will be presented along with several projected future uses.

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UV Induced Densification and Ablation During the Formation of Bragg Gratings In SiO_2 Preforms, Optical Fibers, and Gradient Index Lenses

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ABSTRACT

This report concerns the use of AFM microscopy for fundamental investigations of the interaction between intense UV radiation fields and the near surface regions of SiO_2 based structures. In particular, experiments involving D-shaped optical fibers are currently being done in order to efflciently observe the result *of the UV* interaction with Ge-doped and non-doped regions of the flber. The information obtained could be used to correlate the efficiency of various writing schemes with corresponding optical waveguide processing techniques. Finally, recent results of an ablation experiment performed on one face of a GRIN (Gradient Index) lens in order to produce a phase grating will also be discussed along with a possible application.

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Theoretical Formulations Towards the Solution of Radiation Loss Problems in Optical Waveguide Couplers with Selectable Power Splitting Ratios

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ABSTRACT

The results of a recent formulation which we believe will lead to a closed form theoretical expression for hte radiation losses in tapered optical waveguide couplers with selectable power splitting ratios will be presented. It uses a reformulation of Mazwell's equation in carefully chosen curvilinear geometries which allow the problem to be reduced to simplified forms through the resulting symmetry. The reworking of a previous formulation which only dealt with the much simpler problem of power coupling in a non-uniform geometry along with the solution of a classic waveguide loss problem will also be demonstrated.

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Design and Implementation of an Intelligent Fuzzy Logic-Based Controller for Position/Speed Control and Tracking of Permanent Magnet Motor Drives

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ABSTRACT

In this work, fuzzy logic control is proposed and applied to high performance tracking of AC Permanent Magnet (PM) motors. A track or trajectory is a desired time history of the motor speed or position. This type of high performance drive system is essential in applications such as robotics, electric actuation and guided manipulation where precise movements over a period of time are required. Description of the implemented hardware system is also given. The design of tracking controllers for PM motors is difficult due to motor nonlinearities and unknown load dynamics. Design objectives that are difficult to express mathematically can be easily incorporated in a fuzzy controller by linguistic rules. In addition, implementation of fuzzy controller is simple and straight forward. An important feature is that real-time nonlinearities are not ignored, but no mathematical model is required. The system, also, incorporates techniques to overcome measurement errors and inaccuracies. The control methodology is inherently robust, and is based on simple rules that are derived from the operator's experience. A distinguishing feature of the current research is the by-product goal of developing a marketable, simple, functional and low cost controller, compared to commercially available controllers. The objective is to design the most optimal yet practical controller that can be implemented and marketed, and which gives respectable performance, even when the system loads, inertia and parameters are varying. At the time of writing this report, a number of the components have been designed, built and tested individually, and in various combinations of hardware and software segments. The other work to be completed includes the integration and the start of the implementation of the full system. Subsequent analytical predictions of permanent magnet, AC induction and switched reluctance motor drives will be verified by experimental performance.

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Design of a Microcontroller for PM DC Motor Drives

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ABSTRACT

This work is concerned with the development of a microcontroller-based servomotor position control system for use in aerospace applications. The system was developed to demonstrate i) a practical method of position sensing, ii) a practical method of actuating the servomotor, and iii) the effects of the use of different control algorithms on closed loop system performance. The work presented in this report has involved complete design and construction of the microcontroller, the design of interface (keyboard and display) with particular emphasis on student use in a laboratory environment, and the design and testing of the different control algorithms. During the course of the execution of the laboratory experimental procedure we studied and evaluated the performance of four different control algorithms. The four algorithms studied in the experiment were chosen to provide a cross section of control algorithms currently in use in practice. The algorithms considered here are: bang-bang control, proportional plus integral (PI) control, inner PI speed loop with outer proportional position loop and state variable feedback control. The point of the part of the laboratory experiment dealing with these control algorithms is to select the best control method by evaluating closed-loop performance using each algorithm. The experimental setup, the processing of the data and the results are presented. The design demonstrates technologies that are just gaining widespread support today in industry. The design illustrates that microcontroller can form the heart of a flexible, cost effective control system. The flexibility is unlimited due to the controller being microcontroller based. As can be seen, the techniques employed in the controller designed for the laboratory experiment will likely be seen by the students in their subsequent employment after completion of their college careers. In short, this work contributes a tracking microcontroller which incorporates attractive features such as simplicity, good performance, and automation while utilizing a low cost hardware and software implementation. Additionally, one important feature of the laboratory experiment is that the control function can be modified by simply changing the structure of the control algorithm without any change in the hardware. Thus, several control algorithms can be implemented in a short period of time, and with minimum effort.

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Laser Optogalvanic Spectroscopy of Argon and Neon for Normal and Microgravity Combustion

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ABSTRACT

A commercial laser galvatron containing argon and an Fe-Ne hollow cathode lamp have been separately irradiated in the near UV with a frequency-doubled Nd: YAG-pumped tunable dye laser system. Atomic neon transitions were also proved in the visible region without frequency doubling. Of the over 100 optogalvanic (OG) transitions recorded in the 290.886-320.75 nm region with laser galvatron, we have been able to identify 90 transitions as being due to atomic argon employing the J-L coupling scheme, and the remainder arising from Fe atoms. Of these 80 observed optogalvanic argon transitions, 39 have been identified and assigned to the best of our knowledge for the first time. We have also conducted a detailed study of the OG transitions using the Fe-Ne lamp, especially in the wavelength ranges 291-317 nm and 607-662 nm. More than 160 OG-spectral lines have been recorded in these two wavelength regimes, of which 60 have been successfully assigned to atomic neon transitions. The wavenumbers of the OG spectral lines were cross calibrated using the laser-induced fluorescence (LIF) spectrum of the hydroxyl (OH) radical generated in a propane-air flame. The comprehensive array of laser optogalvanic transitions recorded for argon and neon, in conjunction with rovibronic transitions of the hydroxyl radical, has proved very useful in the reliable and precise calibration of LIF excitation studies of combustion-associated free radicals. The optogalvanic investigations and the associated laser spectroscopic studies of free radicals will prove of value in the understanding and elucidation of both normal gravity and microgravity combustion phenomena.

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Analysis of Thermal State-of-Charge in Solar Heat Receivers

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ABSTRACT

Analytical and numerical results are presented to gain an understanding of the so-called thermal state-of-charge (SOC) problem relating to solar heat receivers. The analytic focus is on NASA Lewis Research Center's Ground Test Demonstration (GTD) system solar heat receiver. The concepts of available power and virtual source temperature are used in the development of time-dependent conjugate and primary SOC functions, which capture the essence of the state-of-charge concept in start-up and transition modes, balanced-orbit mode, and steady-state mode. Baseline conjugate and primary SOC curves are generated based on a priori known baseline system operating conditions. In addition, parametric changes in measurable parameters are made through their non-dimensional counterparts (such as thermal capacitance ratio, dimensionless minimum gas available power, and sun period-total orbit period ratio) to determine the degree of departure from the baseline conjugate and primary SOC curves. For the baseline primary SOC curve in balanced-orbit mode, there is a 33% energy margin (from the minimum SOC line) at sunrise, which indicates safe operation of the solar dynamic system. Furthermore, parametric changes show varying degrees of influence, depending upon the regime of operation. For example, quantitative comparisons in the sensible regime have completely reversed effects in the latent regime since PCM melting and freezing rates contribute a dominant influence on the energy extraction rate from the receiver. Finally, the second conjugate SOC curve is observed to lag (in time) behind the primary SOC curve with respect to operating the solar dynamic system until their respective minimum SOC lines are reached.

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Aerospace Power System Automation - Using Everett Method

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ABSTRACT

In the competitive environment, power customers can choose power suppliers and determine their own load values based on market prices, in order to meet load demand. Scheduling electrical energy among the consumers is a resource allocation problem and would seem amenable to a host of mature operation research algorithms. However, Space Station Freedom's design is evolving as a confederation of separate agents (life support, communication, propulsion, payload, etc.), each with a responsibility to perform a unique function. The real issue is to maximize the collective welfare of the various functional agents. This implies bargaining among the power requesters and the power management agent to produce equitable allocations. Howard University uses a value-driven approach to solve the problem of load shedding in Aerospace power system. In general, resource allocation is constrained by the amount of resources available at any instant, the time at which a resource is needed, and the priority of the need itself. Choosing a schedule of events that satisfies constraints means having the ability to use a value system to make the selection. The value system used, rates these decisions according to their impact upon overall station operation as well as preserves equity for the participants. In addition, them is conflict between supply and demand. The conflict should be mediated or coordinated through pricing balance in the new competitive environment, rather than by mandatory means. In order to reach this objective, the mathematical model of load shedding, in which the objective is payoff function, is set up. The Everett method - Generalized Lagrange Multipliers is employed to solve the problem. This method is different from the Lagrange method, in which the traditional Lagrange multipliers deal with equality constraints and handle inequality constraints with slack variables. Consequently, The Lagrange method can obtain an optimal solution with "stationary points". The aim of Generalized Lagrange multiplier is maximization based on the trial prices λi rather than the location of "stationary points" as with traditional Lagrange multipliers. Therefore, it is suitable to use Everett technique to study the problem of competitive pricing and load shedding in the new competitive environment. The proposed competitive pricing and load shedding approach is tested on National Aeronautics and Space Administration (NASA) benchmark system.

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Artificial Neural Network, Fuzzy Logic and Expert Systems Approaches to Hybrid Electric Vehicle Control System

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ABSTRACT

The paper presents a proposed control scheme for the Hybrid Electric Bus consists of the following modules: ANN based-load forecaster, Fuzzy logic based-controller for super-capacitor voltage control, Expert System (ES) for vehicle performance simulation module. The advantage of the application of artificial intelligence techniques, ANN and fuzzy logic, is mainly due to the computational speed requirement in the real-time environment. Also, relevant are the issues of the complex nonlinear dynamics which the classical tools of optimization, regression analysis, harmonic analysis and time-series techniques can barely handle. The ANN-based load fore caster is designed to predict the power required for the HEV during a complete drive cycle for different loading and operating conditions. The advantage of using ANN is that, ANN is able to perform nonlinear modeling and adaptation. Furthermore, it does not require assumption of any function that relates the input variables to the output variables. Thus, ANN based load forecasting is superior to other traditional algorithmic techniques like regression and time series approaches. The objective of the fuzzy module is to develop a fuzzy rule-based control scheme a monitor the voltage of the super capacitor during charging and discharging periods while satisfying the predicted power from ANN. The voltage of the capacitor is not allowed to fall below certain limit when load is high or the vehicle is accelerating. Also, the capacitor voltage is required not to exceed a specified limit during the charging period when the load is low and vehicle is de-accelerated (and/or regenerative braking issued) so that the capacitor is not overcharged. The ES provides on line consultation to the driver about the vehicle performance corresponding to the optimal velocity pattern. A detailed design of the ANN-based forecaster and fuzzy logic-based voltage controller including data collection scheme, training, generation of fuzzy rules, testing and implementation is presented in this paper. The result of the test data was very promising and the maximum error is less than 9%. The fuzzy and expert system rules were generated using the obtained results from simulation model of HEV. The performance of a hybrid electric vehicle (HEV) is highly dependent on the control strategy used. One of the control issues here is an effective scheme for the heat engine/generator control. If the control is inadequate, the super capacitor voltage can decrease to the extent where the engine is required to drive the vehicle at peak loads and charge the capacitor at the same time. This drastically increases the engine's fuel consumption and emission of pollutants in the atmosphere. On the contrary, if the control is effective, the capacitor's charging periods can coincide with the low load periods, and during the peak load periods the vehicle can be driven by the power supplied by both the engine/generator block and super capacitor. This allows to smoothen the engine/generator output and minimize the fuel consumption and pollution. The work is further extended to develop and test fuzzy control schemes with the objective to smoothen the generator output curve and by this mean achieve a better fuel economy. The advantage of this development is to keep the capacitor's voltage, generator voltage, current and power within the admissible range while taking into consideration the input variable to the controller such as mechanical load curves, capacitor and generator voltages, currents and powers. It also allows the engine/alternator control signal to modulate its output.

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Expert System Architecture for Rocket Engine Numerical Simulators: A Vision

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ABSTRACT

Simulation of any complex physical system like rocket engines involves modeling the behavior of their different components using mostly numerical equations. Typically a simulation package would contain a set of subroutines for these modeling purpose and some other ones for supporting jobs. A user would create an input file configuring a system (part or whole of a rocket engine to be simulated) in appropriate format understandable by the package and run it to create an executable module corresponding to the simulated system. This module will then be run on a given set of input parameters in another file. Simulation jobs are mostly done for performance measurements of a designed system, but could be utilized for failure analysis or a design job as inverse problems. In order to use any such package the user needs to understand and learn a lot about the software architecture of the package, apart from being knowledgeable in the target domain. We are currently involved in a project in designing an intelligent executive module for the rocket engine simulation packages, which would free any user from this burden of acquiring knowledge on a particular software system. The extended abstract presented here would describe the vision, methodology and the problems encountered in the project. The project is funded and supervised by the NASA Lewis Research Center. We are employing object-oriented technology in designing the executive module. The problem is connected to the areas like the reverse engineering of any simulation software, and the intelligent systems for simulation.

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Aerothermo-Structural Analysis of Low Cost Composite Nozzle/Inlet Components

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ABSTRACT

This research is a co-operative effort among the Turbomachinary & Propulsion Division of NASA LeRC, CCMR of NC A&T SU, and the Tuskegee University. Objectives of the research are to develop an integrated aerodynamic, thermal, and structural analysis code for design of aircraft engine components, such as, nozzles and inlets made of textile composites. There can be two approaches to solve these types of problems. One is a multiphysics approach wherein the problem is formulated as a single unified equation involving various disciplines. This equation is solved simultaneously. This approach is attractive, but it is difficult to solve. The second approach is the traditional approach, wherein different models were used in each of the areas and solved independently. The solution from one analysis is mapped to the other and the change of configuration and/or conditions are compared. The analysis is iterated till a convergence is attained. Such an approach is demonstrated with an example of a rocket nozzle made of braided ablative composite material. The lecture highlights the complexities and tediousness involved in this approach. To eliminate some these problems an integrated analytical model for engine components will be developed. This utilizes the existing best codes that were developed by NASA and its contractors for flow, thermal, and structural analyses and integrates them into one using a graphical user interface.

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Numerical Simulations of Wing-Body Junction Flows

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ABSTRACT

The total of the research project is to contribute to the optimized design of fan bypass systems in advanced turbofan engines such as the Advanced Ducted Propulsors (ADP). The immediate objective is to perform numerical simulation of duct-strut interactions to elucidate the loss mechanisms associated with this configuration that is characteristic of ADP. As the first step in the process, a numerical study of wing-body junction flow is being undertaken as it shares a number of characteristics with the duct-strut interaction flow. Also, the flow in a duct-strut configuration essentially involves the interaction between two wing-body junction type of flows. The experimental data from Kubendran et al. (AIAA Journal, Vol. 24, No. 9, pp. 1447–1452, Sep. 1986) have being used for comparison. The code NPARC (version 2.2) is used for numerical simulations. A three block structured grid used for the simulation has been generated using a multisurface algorithm. All the reported simulations have been performed on the CRAY C90 at the Numerical Aerospace Simulation (NAS) facility at NASA Ames Research Center. The results obtained so far indicate reasonable agreement with the mean flow profiles upstream of the wing-body junction. However, the predicted turbulence kinetic energy profiles show deviation from the measurements in the regions far from the wall. The peak value of the measured turbulence kinetic energy is accurately captured by the computations. So far, a two-equation (k-epsilon) turbulence model has been used to obtain converged results. Efforts are underway to explore the efficacy of other turbulence models such as k-omega which is expected to perform better in predicting such separated, turbulent boundary layers as considered here.

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Mechanical Behavior and Analytical Modeling of Melt-Infiltrated SiC/SiC Woven Composite

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ABSTRACT

The desirable properties in ceramic matrix composites (CMCs), such as high temperature strength, corrosion resistance, high toughness, low density, or good creep resistance have led to increased use of CMCs in high-speed engine structural components and structures that operate in extreme temperature and hostile aero-thermo-chemical environments. Ceramic matrix composites have been chosen for turbine material in the design of 21st century civil propulsion systems to achieve high fuel economy, improved reliability, extended life, and reduced cost. Most commercial CMCs are manufactured using a chemical vapor infiltration (CVI) process. However, a lower cost fabrication known as melt-infiltration process is also providing CMCs marked for use in hot sections of high-speed civil transports. Limited samples of a SiC/SiC melt-infiltrated woven composite are being investigated at room and elevated temperature below and above matrix cracking. These samples show graceful failure and toughness at room temperature with a reduction in strength and modulus at elevated temperatures. A generic finite element model is also being developed to predict monotonic and cyclic loading behavior of the woven composite. Use of the initial test data from the woven composite is being used for the development of the analytical model. This model is the first of a iterative process leading towards the development the model's capability to predict behavior at room and elevated temperature for monotonic and cyclic loading. The purpose of this paper is to report on the material and mechanical findings of the SiC/SiC melt-infiltrated woven composite and progress on the development of the finite element model.

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Coupled Brillouin and Shape Memory Alloy Systems for Active Vibration Control

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ABSTRACT

It has been demonstrated that Stimulated Brillouin Sensing (sBs), and Guided Acoustic Wave Brillouin Scattering (GAWBS) sensing schemes are sensitive to fiber parameter and abient variations, i.e., temperature, stress/strain, and fiber doping and corrosion. Recent work has centered on the use of sBs in sensing the degradation of aerospace structures. Success has been achieved in shortening the length of the fiber through sBs threshold sensing while preserving the fiber's sensitivity to its immediate environment. New work has evolved in coupling fiber sensing schemes with Shape Memory Alloys (SMAs) in utilizing the SMAs Shape Memory Effect (SME) as a useful vibration control mechanism. Recent theoretical designs and experimental research results in two directions are addressed. Our first effort is to sputter coat short sections of single-mode optical fibers with 2-6 μm of SMA and test whether the fiber's temperature, and strain, sensing capabilities have been enhanced. The second test is to use narrow diameter SMA wire as a self-control mechanism for a new thin film solar array. However, it must be noted that the purpose of the second component is to critically prevent vibration of the solar array by utilizing the SME from natural heating and cooling which caused by the array's orbit. In short, we plan to create a control grid for the array.

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Photovoltaic-Diesel Hybrid Supervisory Control and Data Acquisition System Design

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ABSTRACT

The design philosophy for this PV-Diesel hybrid system with Supervisory Control and Data Acquisition (SCADA) capabilities is to implement an integrated system that operates as a "cycle-charged diesel" with opportunistic recharging by a photovoltaic (PV) array. Microprocessor-based controllers must monitor system parameters and store data for remote retrieval. The system must contain ports suitable for connection to either a local or remote host computer, as well as provide for a user interface in the form of an LCD screen and a keyboard. This mini hybrid SCADA system, purposed by Savannah State University/Florida Solar Energy Center partnership and developed by Orion Energy Corporation, is designed to meet the above stated objectives. The system design specifications consist of a diesel engine with a 2.8 kW diesel generator with microprocessor-based start controller, a battery with 280 Ah at 48 VDC capacity, and a battery charger with 30 Amps nominal (37.5 max) at 48 VDC. The typical configuration for the 840 W(p) PV array is as a 4 series x 3 parallel 70 W(p) modules. All components of the integrated power system, except the PV array, are mounted on a transportable skid and enclosed in a weather resistant housing. The control algorithm calls for the system controller to start the diesel generator, when battery voltage falls below 40% preset state of charge (SOC), to rapidly recharge the battery to approximately 95% SOC. The PV array will recharge the battery when energy is available. With the 840 W(p) PV array, the diesel generator will start about 120 times a year, running approximately 760 hours per year (9% duty cycle). In addition to maintaining battery charge, the controller also monitors battery voltage, battery, load, array, and rectifier current, and battery and ambient temperature, as well as provides load management functions. Collected data is archived on-board for periodic remote retrieval.

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Supervisory Control and Data Acquisition Experimental Plan Using Photovoltaic-Diesel Hybrid Systems

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ABSTRACT

The lack of electrical energy in the rural communities of developing countries is well known. Equally known is the economic unfeasibility of providing much needed energy to these rural regions via electric grids. The economic advantage of renewable energy (RE) over conventional forms in meeting some of the energy needs of rural areas in developing countries has been well documented Several efforts involving the use of renewable have been made, over the years, to address the problem of energy shortages in developing countries. However, these efforts have met with another impediment: the lack of personnel in the developing countries knowledgeable of, or skilled in, the operation and maintenance of renewable energy systems. Training programs on the installation, operation, and maintenance of RE systems are used to overcome this impediment. However, trained personnel must be allowed to complete the learning curve before they can be reasonably expected to exert meaningful impact on the energy supply problem in their countries. The use of Supervisory Control and Data Acquisition (SCADA) arrangement would enable experts at remote locations to provide technical assistance to local trainees while they acquire a measure of proficiency with the system. Upon full mastery of the technologies, the indigents may also employ similar SCADA arrangements to remotely monitor and control their constellation of RE systems, which expectedly would be scattered over large rural areas. The portability of the Ultra Small Aperture Terminal (USAT) and the versatility of NASA's Advanced Communications Technology Satellite (ACTS) as well as the advantages of Ka-band satellites potentially provide an opportunity for meeting the energy challenges of rural communities in developing countries. Both the satellite ground station power supply and the consumer RE system could be supervised and controlled by an expert in a remote location using a SCADA system. This project is designed to test the performance of ACTS in a SCADA arrangement for remote monitoring of the health and performance of all major photovoltaic subsystems, and investigating load control and battery charging strategies to maximize battery capacity and lifetime, and minimize loss of critical load probability. This experiment will test and refine a SCADA system before its implementation in remote rural area. Two custom designed PV-diesel hybrid SCADA systems, one located at Savannah State University and the other located at Florida Solar Energy Center, will be tested in this type of arrangement. The SCADA system at one terminal will monitor key system parameters at the other, remotely, to determine the health and performance of its power generation components, and provide remote control of system's operation. The SCADA system will interface with both satellite and terrestrial communications networks. The Ka-band Satellite link will use Ultra Small Aperture Terminal (USAT) ground stations and NASA's Advanced Communications Technology Satellite (ACTS). The terrestrial link will use Integrated Services Digital Network (ISDN). The system will also be configured for local interface via a dedicated RS232 port.

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LeRC HBCUs CONFERENCE

Narrow Angle Diversity Study Using ACTS Ka-band Signal with Two USAT Ground Stations

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ABSTRACT

Two ultra small aperture terminal (USAT) ground stations, separated by 1.2 km in a narrow angle diversity configuration, received a continuous Ka-band tone sent from Cleveland Link Evaluation Terminal (LET). The signal was transmitted to the USAT ground stations via NASA's Advanced Communications Technology Satellite (ACTS) steerable beam. Received signal power at the two sites was measured and analyzed. A dedicated datalogger at each site recorded time-of-tip data from tipping bucket rain gauges, providing rain amount and instantaneous rain rate. WSR-88D data was also obtained for the collection period. Eleven events with ground-to-satellite slant-path precipitation and resultant signal attenuation were observed during the data collection period Fade magnitude and duration were compared at the two sites and diversity gain was calculated These results exceeded standard diversity gain model predictions by several decibels. Rain statistics from tipping bucket data and from radar data were also compared to signal attenuation. The nature of Florida's subtropical rainfall, specifically its impact on signal attenuation at the sites, was addressed.

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Integration of Microstructure in a Thermomechanical Processing Model

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ABSTRACT

The development of a microstructure based deformation-processing model has received a great interest recently. Constitutive relationships, for microstructure characteristics during hot forging, have been developed on the basis of a dislocation density evolution model, derived from the original work by Sandstorm and Logneborg. The microstructure models, for work hardening, dynamic recovery, and dynamic recrystallization stages, are presented for IN718 in high temperatures (about 1000°C) when the δ phase dissolved. Numerical solutions for the equations are made on Pietrzk's approach. Experimental validations are carried out by using the published data in literature for IN718. The results indicate that the dislocation density evolution model for hot forging process predicts the hot flow stress behavior of IN718 very closely with the experimental data. The microstructure evolution model has been applied to develop an integrated mathematical model to represent the thermomechanical behavior of materials and microstructure during metal forging. The model development is based on the finite element solution of the thermoviscoplastic deformation of metals coupled with the microstructure based deformation-processing model describing the microstructure evolution involving work hardening, recovery, recrystallization and grain size distribution. The procedure for the integration of the microstructure model into the macro finite element model has been established. Computed results for both macro and micro phenomena during metal forging are going to be experimentally verified for IN718 and TiAl.

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LeRC HBCUs CONFERENCE

Knowledge Preservation and Web-tools

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ABSTRACT

We propose a library of “netbooks” as part of a national effort, preserving the wisdom of the early Space Program. NASA is losing its rocket scientists who designed the great systems of the past. Few new systems of similar ambition are being built—much of the expertise that took us to the Moon is evaporating. With retiring NASA designers, we work to preserve something of the expertise of these individuals, developed at great national cost. We show others the tools that make preservation easy and cheap. Retiring engineers and scientists can be coached into speaking (without charge) into recording devices about ideas not widely appreciated but of potential future value. Transcripts of the recordings and the audio itself are combined (cheaply) in netbooks accessible via a standard web-browser (free). Selected netbooks are indexed into a rapidly searchable system, an electronic “Library. “ We recruit support in establishing a standards committee for that Library. The system is to be a model for access by the blind as well as for preservation of important, technical knowledge.

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LeRC HBCUs CONFERENCE

Development of Synchronously Scanned OPO CARS as a New Probe for Hostile Environments

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ABSTRACT

This project involves the development and demonstration of a new laser technique for probing hostile environments such as combustion and plasmas. CARS (Coherent Antistokes Raman Spectroscopy) is a mature nonlinear form of Raman spectroscopy that has been used as an effective tool for studying such environments. This new technique fixes a major problem with CARS (limited tunability) and introduces a novel concept in laser spectroscopy called Single Wavelength Detection (SWD). Use of this technique with SWD allows rejection of the three major sources of spectral interference that plague Raman spectroscopy: fluorescence, background, and Rayleigh scattered light.

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LeRC HBCUs CONFERENCE

Tennessee State University Research Project for Increasing The Pool of Minority Engineers

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ABSTRACT

The NASA Lewis Research Center funded the Tennessee State University (TSU) Research Project for Increasing the Pool of Minority Engineers. The goal of increasing minority participation in engineering is accomplished: (1) through precollege programs which introduce and expose minority youth to engineering careers and the required academic preparation to make high school graduation, engineering school attendance and engineering careers a reality; (2) by providing scholarships to honor students majoring in engineering areas of interest to NASA; (3) familiarizing precollege students and engineering students with the engineering profession and with NASA through field trips to industrial sites and through summer internships at NASA LeRC; and (4) through research exposure and experiences through NASA LeRC sponsored research based in the College Of Engineering and Technology at Tennessee State University.

1996-1997 NOTEWORTHY RESULTS

A total of 71 African-American youth participated in three Minority Introduction To Engineering (MITE'97) precollege workshops held on the campus of Tennessee State University during the 1997 summer session. The participates came from 16 states (28% from Florida and 23% from Tennessee); 38% were females and 62% were males. Each workshop was two weeks long and exposed the participants to aeronautics, algebra and trigonometry, computer graphics, and African-American Literature, in addition to five engineering laboratories including aeronautics, CAD, electronics, fluids, and structures. The typical MITE'97 participant can be characterized as an African-American male, 16 years old, promoted to the 11th grade, and had taken Algebra I, Algebra II, and Geometry and had some exposure to computers. Two Engineering and Technology Saturday Previews were conducted with 63 high school students in attendance. The Previews introduced the participants to the engineering profession through hands-on laboratory experiences in five engineering laboratories. One group of participants came from Birmingham Alabama. The other group of participants came from Indianapolis Indiana. Five TSU engineering students received NASA-LeRC sponsored scholarships. The average GPA for the five scholars is 3.331. Two of the scholars are engaged in on-going NASA-LeRC funded research at TSU. The TSU Research Project for Increasing the Pool of Minority Engineers was an overwhelming success; all goals and objectives were met or exceeded. The 1996-1997 Research Project provided 139 African-American students with academic and research experiences in technical areas of interest to NASA. In addition, these participants gained some degree of familiarity with the NASA-Lewis Research Center, its mission an its work force needs.

HISTORICAL OVERVIEW OF THE NASA LeRC—TSU RESEARCH PROJECT

The NASA LeRC—TSU Research Project for Increasing the Pool of Minority Engineers began in 1990 with 25 participants. To data, 633 high school students (46% female) have participated in MITE. Of the seniors who participated in MITE: 70% attend college, 74% of those who attend college major in SMET degree programs, and 19% attend TSU. Fifteen (15) TU engineering students have received NASA LeRC scholarships. Ten (10) scholars have interned at NASA Lewis Research Center. One scholar is now a Ph.D. student at Rensselarer Polytechnic Institute. His thesis advisor is his former NASA LeRC technical Monitor (faculty intern) from two previous summer internships at Lewis.

The NASA LeRC-TSU Research Project works!

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LeRC HBCUs CONFERENCE

Experimental Characterization of Two-Dimensional Convective Melting of Packed Ice Bed

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ABSTRACT

An experimental investigation is conducted to study the melting characteristics of a horizontally arranged packed bed. This experiment serves as a benchmark case for further validation of numerical modeling on two-dimensional convective melting of a packed bed. The packed bed consists of ice grains of an initially uniform, segmental-cylindrical shape and is initially saturated with still liquid. As the liquid flows through the bed, the solid grains melt. The downstream of the packed bed is bounded by a perforated plate through which liquid can flow while the ice particles are retained. Both vertical and horizontal flow configurations are tested. Prom the digital video images the local packed bed thickness is measured under controlled flow rate and supply water temperature, and the melting rate is determined. The temperature distribution of the melt and ice grains for horizontal flow are determined by the use of an infrared camera over the open test section and the thermocouples along the flow direction in the liquid. The melting rates are presented as a function of upstream flow velocity, upstream flow temperature and initial packed mass. Within the experimental conditions, it is found that two-dimensional melting characteristics is strongly influenced by combined thermal diffusion and fluid-melt mixing. A mixing zone is quantified, and the repacking of melting particles can be characterized by a transitional Reynolds number, based on the initial particle diameter, of 1,125.

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LeRC HBCUs CONFERENCE

Non-Destructive Determination of Time-Dependent Thermal Conductivity of Melting Two-Phase Medium

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ABSTRACT

Work continues to apply the fractal methodology with a Representative Unit Cell (RUC) model to determine the effective thermal conductivity of a two-dimensional test bed, which consists of ice-water mixture and undergoes a convective melting process. Pictures of the cross-section of melting section were taken using an infrared camera. A time-dependent packing and particle size variations are processed to provide digital data for measuring local fractal dimensions. Local fractal dimensions are calculated using an imaging analysis model. The calculated fractal dimensions are given as an input to the equivalent Representative Unit Cell (RUC) model to obtain the effective thermal conductivity. New results are presented for typical experimental processes under different flow velocity, temperature and initial packing mass. The method demonstrates a potential application of nondestructive method to determine multiphase thermal properties under time-dependent processes in which the steady-state equilibrium method fails.

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LeRC HBCUs CONFERENCE

Numerical Modeling of Two-Dimensional Convective Melting of Granular Packed Beds

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ABSTRACT

Packed beds of solid particles are widely used in venous processes in chemical, metallurgical, pharmaceutical and building Transport phenomena occurring during these processes can be divided into two categories. One is that with constant, rigid geometry in solid phase. The other is one with the solid phase undergoing phase change. During recent years, considerable attentions have been received to study phase changes within porous materials, not only because of the importance of these processes (for example, in situ vitrification of hazardous waste) but also because of the complexity involved in such physical phenomena. Similar physical processes can be realized in safety evaluation and disaster prevention of nuclear reactors. It is very important to estimate the heat transfer and melting rate of the packed beds formed by fragments of fuel rods within the reactor as a result of accidents. Recent research includes melting of ice within a porous media with conducting fins inserted within it and numerical analysis of convective melting of packed beds. In this study, a two-dimensional numerical model is presented to include the effect of density difference between the packed solid particles and melt liquid. The model is an extension of the one developed by Sabau and Tao (1997), which describes one-dimensional flow and quasi-steady convective melting. The computational domain is divided into two subdomains: one is the melting packed bed and the other is the fluid consisting of the supply fluid and melt. To simplify the formulation, only the case where the fluid and melt are the same species is considered. Darcy flow is considered in the packed bed while the viscous flow is modeled in the fluid domain. At the interface of two subdomains, a moving boundary condition, based on mass balance, is specified. The splitting method is applied to the two-dimensional, implicit discretized equations. Underrelaxation is utilized to assure the stability of the computational scheme. The typical results are presented.

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LeRC HBCUs CONFERENCE

Isotopic Enrichment of Boron in the Sputtering of Boron Nitride with Xenon Ions

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ABSTRACT

An experimental study is described to measure the isotopic enrichment of boron. Xenon ions from 100 eV to 1.5 keV were used to sputter a boron nitride target. An ion gun was used to generate the ion beam. The ion current density at the target surface was approximately 30 $\mu A/cm^2$. Xenon ions impinged on the target surface at 50° angle to the surface normal. Since boron nitride is an insulator, a flood electron gun was used in our experiments to neutralize the positive charge buildup on the target surface. The sputtered secondary ions of boron were detected by a quadrupole mass spectrometer. The spectrometer entrance aperture was located perpendicular to the ion beam direction and 10 mm away from the target surface. The secondary ion flux was observed to be enriched in the heavy isotopes at lower ion energies. The proportion of heavy isotopes in the sputtered secondary ion flux was found to decrease with increasing primary ion energy from 100 to 350 eV. Beyond 350 eV, light isotopes were sputtered preferentially. The light isotope enrichment factor was observed to reach an asymptotic value of 1.27 at 1.5 keV. This trend is similar to that of the isotopic enrichment observed earlier when copper was sputtered with xenon ions in the same energy range.

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LeRC HBCUs CONFERENCE

Characterization of Flow Behind The Fan of a Turbofan Engine

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ABSTRACT

A three-year research grant was awarded to Tuskegee University by NASA Lewis Research Center (LeRC) to perform research on characterizing the fan wake flows of turbofan engines. Emphasis is placed on determining how the fan wake flow contributes to the noise produced by the engine. Experimental (hot-wire) data obtained downstream of the fans of two different engine models have been supplied by LeRC. FORTRAN codes have been developed to perform the data analysis. Typical results obtained from the data analysis include estimates of mean and turbulent velocities, autocorrelation, autospectra, two-point correlation, wave number frequency spectra, and integral time scales at various locations downstream of the fan. The results of the analysis may provide insights as to how the fan blades and/or stator vanes might be redesigned so that the engine model generates less noise. Furthermore, the results can be used to calibrate codes developed to predict the flow field, and as input to codes developed to predict the noise generated by the engine model.

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Electrodeposited $CuInSe_2$ Thin Film Junctions

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ABSTRACT

We have been investigating the electrochemical deposition of polycrystalline thin films and junctions based on copper indium diselenide (CIS). Electrodeposition is a simple and inexpensive method for producing thin-film CIS. Film stoichiometry and semiconductor type is controlled via the deposition potential. We have produced both p and n type CIS thin films as well as CIS p/n junctions from a single aqueous solution. Film morphology and stoichiometry was determined using Scanning Electron Microscopy, Energy Dispersive Spectroscopy, and X-Ray Diffractometry. Optical bandgaps were determined for these films using transmission spectroscopy. Capacitance-Voltage measurements were performed on A1 Schottky barriers on p-type CIS to determine carrier densities. I-V characteristics were measured for the Schottky barriers and p/n junctions to verify diode behavior and determine barrier heights.

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Parallel Object-Oriented Programming in Network Environment

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ABSTRACT

We are designing, and implementing a strictly typed modular language framework that supports the development and use of parallel cluster computing paradigms. A parallel paradigm is a general control structure, such as a master-server network, a pipeline, a grid, or a divide-and-conquer tree, that is common for a whole class of parallel algorithms. Once an appropriate paradigm has been developed, it can be used to generate parallel solutions for different problems. Because parallel paradigms provide all the coordination and synchronization that are needed for parallelism, their clients must provide only problem-specific sequential code. Thus, parallel paradigms are generic algorithms that can be used to instantiate specific parallel applications. We call our proposed language Paradigm/SP and use it (1) to specify general parallel paradigms and (2) to derive particular parallel applications from such general paradigms. We have implemented a Paradigm/SP compiler and an interpreter. We utilize the Paradigm/SP compiler and interpreter to test specific paradigms and their derived applications. Once we have established the validity of a Paradigm/SP program, we convert it into efficient C code that runs on top of a cluster-computing library, such as PVM. In this talk, we present the essence of parallel paradigms through a case study of one specific paradigm. We outline the master-server probabilistic paradigm and then demonstrate how it can be used to derive parallel solutions of two concrete problems, the traveling salesperson problem and the knapsack problem. We also characterize the cluster performance of the derived solutions.

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WHY COSTING IS IMPORTANT ON HBCU GRANTS

WHY IS COST IMPORTANT?

COST IS OUR ONLY FISCAL MEASURE OF ACTUAL WORK ACCOMPLISHMENT. IT CAN BE UTILIZED BY MANAGEMENT TO EVALUATE THE EFFICIENCY & EFFECTIVENESS OF BUDGET EXECUTION ON OUR PROGRAMS.

WHAT DOES FORWARD FUNDING MEAN?

FORWARD FUNDING IS EXPRESSED AS EITHER

① THE AMOUNT OF FUNDING THAT ONE'S PROGRAM OR CONTRACT WILL NOT "COST" DURING THE CURRENT FISCAL YEAR. OR

② THE PERIOD OF TIME THAT YOUR CONTRACT IS FORWARD FUNDED INTO THE NEXT FISCAL YEAR. (NOTE: RB's GUIDELINE IS THAT FORWARD FUNDING BE LIMITED TO NO MORE THAN 2 MONTHS ON ALL OAST CONTRACTS)

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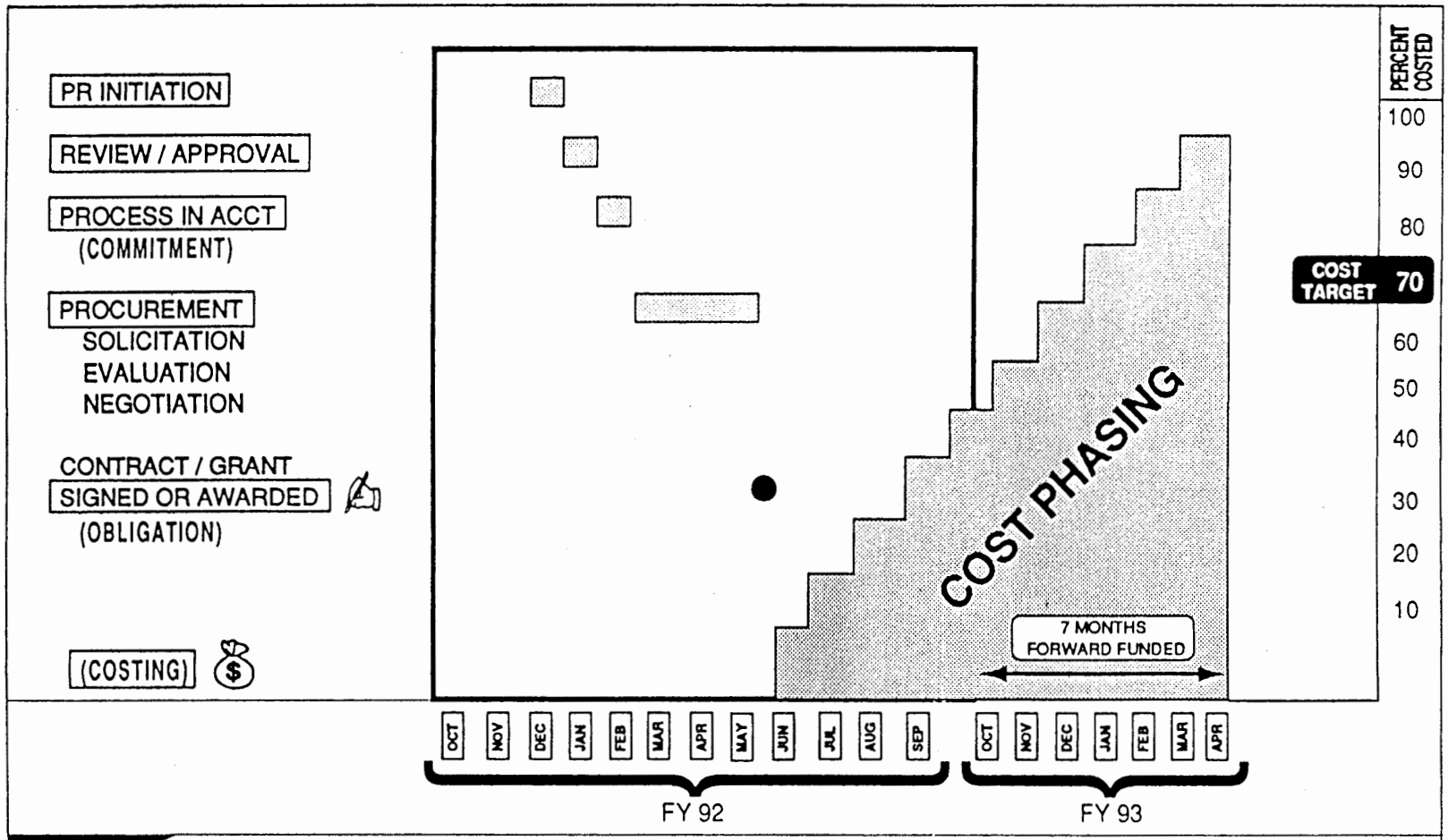
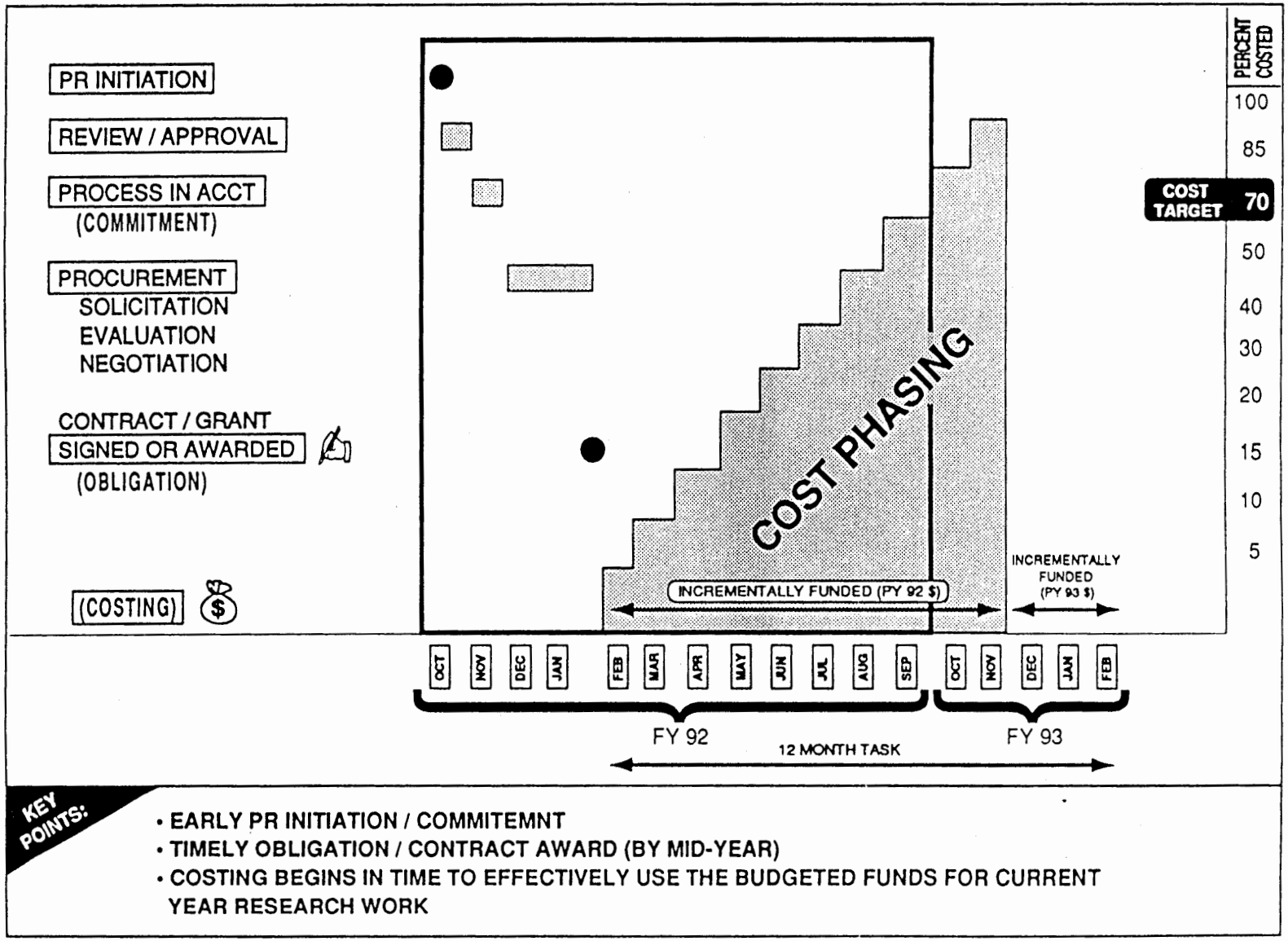
EXAMPLE OF POOR COST MANAGEMENT



KEY POINTS:

- EARLY RTOP APPROVAL AND EARLY 506 RELEASE NEED TO TRANSLATE INTO EARLY COMMITMENTS AND OBLIGATIONS
- YOU CAN'T COST FUNDS THAT ARE NOT OBLIGATED -- LATE FISCAL YEAR CONTRACT AWARDS EQUATE TO MINIMAL COST

EXAMPLE OF GOOD COST MANAGEMENT



KEY POINTS:

- EARLY PR INITIATION / COMMITEMNT
- TIMELY OBLIGATION / CONTRACT AWARD (BY MID-YEAR)
- COSTING BEGINS IN TIME TO EFFECTIVELY USE THE BUDGETED FUNDS FOR CURRENT YEAR RESEARCH WORK

COST MANAGEMENT

⚙ CHECKING ACCOUNT ANALOGY ⚙

- CODE R POLICY ALLOWS 2 MONTHS OF FORWARD FUNDING ON CONTRACTS (BEYOND 9/30) AND A CARRYOVER OF 30% OF YOUR BUDGET ALLOCATION TO COVER EXPENDITURES IN THE FOLLOWING FISCAL YEAR

- HOW MANY MONTHS OF FORWARD FUNDING DO YOU MAINTAIN IN YOUR PERSONAL CHECKING ACCOUNT?

- FLIGHT CENTERS AND MAJOR AGENCY PROGRAMS OPERATE WITH LESS THAN 2 WEEKS OF FORWARD FUNDING INTO THE FOLLOWING FISCAL YEAR

- EXTERNAL AUDIT ORGANIZATIONS CAN'T UNDERSTAND WHY WE ASK FOR FUNDS IN OUR BUDGET REQUEST THAT WE WON'T SPEND IN THE CURRENT FISCAL YEAR.

JJ/GF/1/4/93/NEW AERO AA

Cost Management

- NASA MUREP
  - At least 80% of funds should be costed by the end of Federal fiscal year (September 30)
- NASA MUREP Grantees
  - Incremental funding of large $ value grants or cooperative agreements
  - Minimize forward funding beyond 2 months into the following fiscal year
  - 100% of funds should be encumbered by the end of the grant year; funds not encumbered will be deducted from the first incremental funding, actual carryover will be deducted from the second incremental funding

How Can I Improve My Program's Cost Performance

RB Recommendations

① Timelier initiation of procurements
- "Long leadtime" acquisitions (1st Qtr)
- Planning PR's / initiations use while awaiting 506 (1st Qtr)
- Small purchases / off-the-shelf buys (2nd Qtr)
- Tasks on Support Service Contracts (1st Half of Year)

② Expanded use of "Incremental Funding" of Contracts
- Recommended 2 actions per year (1-1st Qtr; 2-Midyear)
- Avoid multiyear / 100% funding up-front scenarios
- Use incremental funding on major fixed-price contracts also

③ Limit forward funding on incrementally-funded contracts (or major tasks on Support Service Contracts) to only one month

④ Implement a one-time adjustment to start dates on major grants / contracts that are not incrementally funded (startup in 1st Qtr, NOT 4th Qtr)

⑤ Ensuring that all legitimate accrued cost on your program is recorded in your Center fiscal systems in a timely and accurate manner

⑥ Base Budget Requests upon how much $ your program will be able to cost over the 12/1/97 - 12/1/98 time frame

Office of Aeronautics
National Aeronautics and Space Administration

228-Cost Mgmt.10/8/96.EH

RECOMMENDATION

- SUBMIT ALL NECESSARY INFORMATION BILLING TO YOUR COLLEGE FINANCE, ACCOUNTING, OR BILLING OFFICES ON A TIMELY BASIS (AT LEAST ONCE PER MONTH).

- INSURE THAT YOUR COLLEGE BILLING OFFICE SUBMITS REQUIRED BILLING INFORMATION TO NASA LEWIS EACH MONTH SO THAT LEWIS MAY PROPERLY REFLECT ACCURATE UP-TO-DATE COSTING ON YOUR HBCU GRANT.

Donald J. Campbell

Donald J. Campbell is Director of the National Aeronautics and Space Administration's Lewis Research Center in Cleveland, Ohio. He was appointed to this position by NASA Administrator Daniel Goldin on January 6, 1994.

As Director, Mr. Campbell is responsible for planning, organizing, and directing the activities required to accomplish the missions assigned to the Center. Lewis is engaged in research, technology, and systems development programs in aeronautical propulsion, space propulsion, space power, and space sciences/applications. Campbell is responsible for the day-to-day management of these programs, which involve an annual budget of approximately $1 billion, just under 2800 civil service employees and 2000 support service contractors, and more than 500 specialized research facilities located near Cleveland Hopkins International Airport and at Plum Brook Station in Sandusky, Ohio.

Campbell earned a bachelor's degree in mechanical engineering from Ohio Northern University, a master's degree in mechanical engineering and did predoctoral work at Ohio State University. He completed the Senior Executive Seminar in Management at Carnegie Mellon School of Urban and Public Affairs and the Federal Executive Institute Executive Leadership program. He also completed several senior management courses at Brookings Institute.

Campbell began his government career in 1960 as a test engineer for gas turbine engines and engine components in the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio. He then worked as a project engineer and later as a program manager for advanced airbreathing propulsion systems.

From February to July 1986, Campbell was assigned as an interim Directorate Chief during the implementation of the National Aerospace Plane (NASP) Program Office, Wright-Patterson Air Force Base. He was Acting Director of the NASP Technology Maturation Directorate. In 1987, he became Acting Deputy Director of the Aero Propulsion Laboratory. In 1988, he was selected for the rank of Senior Executive Service and was appointed Deputy Program Director for the Propulsion System Program Office, Aeronautical Systems Division. He was the senior civilian executive for development and acquisition of new and derivative gas turbine engines for operational aircraft. In 1990, he was appointed Director of the Aero Propulsion and Power Laboratory. He was responsible for the Air Force propulsion and power research and development in the areas of gas turbine engines, ramjet engines, aerospace power systems, and fuels and lubricants.

In 1992, he was named Director of Science and Technology, Office of the Assistant Secretary of the Air Force for Acquisition, Washington, D.C. In this capacity he monitored the Air Force Science and Technology program and other selected research, development, technology, and engineering programs.

Campbell and his wife, Helen, have four children.

Dr. Michael J. Salkind
President, Ohio Aerospace Institute

Michael Salkind was appointed President of the Ohio Aerospace Institute in January 1990. OAI is a consortium of nine Ohio universities, private industry, NASA Lewis Research Center in Cleveland, and Wright-Patterson Air Force Base in Dayton. Its mission is to facilitate collaboration among industry, universities, and federal laboratories to enhance Ohio and U.S. economic competitiveness through research, education, and technology adaptation.

Before his appointment, Dr. Salkind served as Director of Aerospace Sciences, Air Force Office of Scientific Research, in Washington D.C. for 10 years. He was Chief of Structures at NASA Headquarters in Washington, D.C. from 1976 to 1980. From 1964 to 1975, he was with United Technologies Corporation as Chief of Advanced Metallurgy in their corporate research lab and then Chief of Structures and Materials at the Sikorsky Aircraft Division. He received his bachelor's and doctoral degrees in Materials Engineering from Rensselaer Polytechnic Institute in Troy, New York.

A fellow of the American Association for the Advancement of Science and an evaluator for the Accreditation Board for Engineering and Technology, he has published more than 40 articles and a book entitled Applications of Composite Materials.

He has also served on the adjunct faculty of The Johns Hopkins University, University of Maryland, and Trinity College in Hartford, Connecticut.

Dr. Julian M. Earls

Dr. Julian M. Earls, Deputy Director for Operations, NASA Lewis Research Center is a native of Portsmouth, Virginia. He earned the Bachelor's Degree, with distinction, in Physics from Norfolk State University; the Master's Degree in Radiation Physics from the University of Rochester School of Medicine; and the Doctorate Degree in Radiation Physics from the University of Michigan. Also, he earned the equivalent of a second Master's Degree in Environmental Health from the University of Michigan and is a graduate of the Harvard Business School's prestigious Program for Management Development. He has received the NASA Medal for Exceptional Achievement on two separate occasions.

He has 21 publications, both technical and educational. He has been Distinguished Honors Visiting Professor at numerous universities throughout the Nation and is an adjunct faculty member at Capital University, Columbus, Ohio. He was an adjunct faculty member at Cuyahoga Community College in Cleveland, Ohio. He has served on the Visiting Committee and the Board of Overseers at Case Western Reserve University, the Board of Trustees at Cuyahoga Community College, and recently was appointed by the Governor of Ohio to serve on the newly reconstructed Board of Trustees for Central State University.

Dr. Earls has received numerous honors for his community services. He has been designated the Black College Graduate of Distinction by the National Urban League and has been honored by Norfolk State University and the National Association for Equal Opportunity in Higher Education. He was inducted into the inaugural class of the National Black College Alumni Hall of Fame with such distinguished individuals as Dr. Martin Luther King, Jr. and Justice Thurgood Marshall. Recently he was honored by being among the nine individuals included in the Strong Men and Women; Excellence in Leadership Series by Virginia Power and North Carolina Power Companies. Others who have been included in the Series were: Dr. Johnnetta Cole, President of Spelman College; Henry Aaron, member Baseball Hall of Fame; Dr. John Hope Franklin, noted historian; retired General Colin Powell; Michael Jordan, Chicago Bulls basketball star; and noted poet, Maya Angelou. Dr. Earls is co-founder of the Development Fund for Black Students in Science and Technology which awards scholarships to black students who major in technical disciplines at Historically Black Colleges and Universities.

Dr. Earls is an avid runner and has run over 10,000 miles in the past five years. He has entered and successfully completed 15 marathons, including the Boston Marathon. He is married to the former Zenobia Gregory of Norfolk, Virginia, a Reading Curriculum Specialist in the Cleveland School System. They have two sons. Julian, Jr., a neurologist, is a graduate of Howard University and Case Western Reserve University School of Medicine. Gregory, a cinematographer, is a graduate of Norfolk State University and the American Film Institute in Hollywood, California.

Dr. Sunil Dutta

Dr. Sunil Dutta is Program Manager for Small Disadvantaged Businesses (SDBs) at the National Aeronautics and Space Administration's Lewis Research Center, Cleveland, Ohio. Appointed to this position in 1992, he is responsible for implementing policies that ensure the Small Disadvantaged Businesses (SDBs) and Historically Black Colleges and Universities (HBCUs) are encouraged and afforded and equitable opportunity to compete for NASA contracts and research grants. The goal is to increase R&D contracts with SDBs and research grants with HBCUs at Lewis Research Center. Before assuming the present position, his career has been devoted to research and development of materials science and technology, particularly in the area of processing, characterization, and mechanical behavior of high performance ceramics and ceramics matrix composites, for heat engines and high speed civil transport applications. In addition, he monitored numerous R&D contracts and grants for more than 10 years as project/program manager.

Dr. Dutta joined NASA Lewis Research Center in 1976 after 8 years at the U.S. Army Technology Laboratory, Watertown, Massachusetts. Born in India, he received his B.Sc (Hons), and M.S. from Calcutta University, and M.S. and Ph.D. from the University of Sheffield, England. He also received an MBA degree from Babson College, Wellesley, Massachusetts.

Dr. Dutta has written more than 50 publications including 4 patents and 5 chapters in books.

He is a Fellow of the American Ceramic Society, and the Institute of Ceramics in England. He is listed in American Men and Women in Science, Who's Who in Engineering, and Who's Who in the United States.

Dr. Dutta was invited to Japan for one year as Nippon Steel Endowed Chair Visiting Full Professor, at the University of Tokyo's Research Center for Advanced Science & Technology. Since 1987, he visited Germany, Japan, Korea, Singapore, Australia, and India to present invited technical papers/lectures. Also, actively consulted for industry and government including the CSIR (Council of Scientific and Industrial Research) laboratories in India, under the United Nations Development Program (UNDP).

He has actively participated in Local School PTA programs, as Vice-president of Canterbury Homeowners Association, as President of India Association in Boston, Massachusetts, and in Cleveland, Ohio; and co-convener of 5th biennial National Convention of All Asian-Indians in North America.

Dr. Dutta and his wife Kabita reside in Westlake, Ohio. They have three children.

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The purpose of this Historically Black Colleges and Universities (HBCUs) Research Conference was to provide an opportunity for principal investigators and their students to present research progress reports. The abstracts included in this report indicate the range and quality of research topics such as aeropropulsion, space propulsion, space power, fluid dynamics, designs, structures and materials being funded through grants from Lewis Research Center to HBCUs. The conference generated extensive networking between students, principal investigators, Lewis technical monitors, and other Lewis researchers.

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